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DEVELOPMENT OBJECTIVES

FOR A DIGITAL CONTROL CONSOLE FOR USE WITH AN ON-LINE MEASURING SYSTEM

1. INTRODUCTION.

The government is considering an on-line measuring system in which the measuring is done on a digitized photo interpreter's light table. In order to fully evaluate this concept, the government wishes to develop a pilot operational unit consisting of a measuring light table, tied to a computer through a simple input station (the light table is not a part of these Development Objectives.)

The government has considerable equipment utilizing on-line measuring systems. This equipment has the disadvantage of being too expensive and complex for general use. Since the P.I.'s primary equipment is a light table with a traversing microscope, the cheapest way of automatically extracting X and Y coordinates appears to be by measuring the traverse of the microscope. To reduce costs, the digitizing equipment will be removable; i.e., the interpreter will roll the input station console to his light table and mount the digitizers. In this manner, one set of digitizers and an input console might serve up to 4 light tables.

2. CONCEPT.

2.1. Purposes. This development will provide an electronic system which will convert the output of two [redacted] Digital Linear Measuring System "DIG" reading heads into a computer input format common with that generated by other on-line in-house equipment. The control panel must also be identical to or very similar to that of other in-house on-line systems to simplify the training problem.

2.2. Scope. The contractor will be responsible for fabrication of the following: (1) a control panel with integral visual display; (2) a portable cabinet; and the necessary electronic decoders, synchronizers, buffers, special character generators, etc. necessary to convert the encoded data from the reading heads and from the control panel into a signal which will be accepted by our computer utilizing existing programs; and (3) two "DIG" reading heads will be supplied by the government as GFE for final check out. Since most of the in-house on-line systems utilize [redacted] components, it is desirable to use compatible equipment to the greatest

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extent possible in order to reduce the maintenance and training problem. Although the contractor will not be responsible for mounting the "DIG" encoder heads or building the light table, he will be responsible for checking out and demonstrating the successful operation of the entire electronic system on-line with our Univac 494 computer.

3. REQUIREMENTS.

3.1. Input Devices. The input devices shall consist of two reading heads (only one of which will be furnished the contractor for check out, the other will be purchased and used in modifying the light table) and a control panel. Each reading head will generate a coded signal which will identify the position of that head with respect to its axis. The control panel shall enable the operator to pre-set the counters and to feed auxiliary information to the computer through various switches. The control panel shall also provide a visual digital display of the relative position of each of the two reading heads.

3.1.1. Reading Heads. The reading heads shall be [redacted] "DIG" reading heads. Two heads will be required for the final assembly (one for each axis).

3.1.2. Control Panel. The control panel shall be a Computer Measurements Company control panel model 2825A or equivalent.

3.2. Signal Processing Device. The signal processing device shall provide a direct communication link between the coordinate measuring equipment and a central computer on a real time basis. Transmission between the computer and the remote station is to be via two PWC S4193 cables or equivalent (One wire in the cable is for send, one wire is for receive and one or two wires are for ground) this cable will be provided. (Steps have been taken to reduce interference from outside sources). One transmission cable, initiating at the central computer site, is to be connected to a Teletype Model KSR35 page printer. The contractor, however, is to have no responsibility for the Teletype except for consideration of placement and possible electromagnetic interference from it. The second cable from the computer is to be connected to the signal processing device. There will be no data connection between the teletype and the signal processing device except through the computer link.

3.2.1. Transmission Interface.

3.2.1.1. Transmission is asynchronous with the rate of transmission to be fixed at 1200 bits per second ± 1% tolerance, and is binary serial.

3.2.1.2. A negative voltage (optimum - 10 volts) represents off or marking (1), a positive voltage (optimum + 10 volts) represents on or spacing (0). The signals should have a high impedence.

3.2.1.3. In addition to the information bits to be transmitted, two pulsing bits must be transmitted for each character. A start pulse is a space (0) and is of the same duration as that of the other bits. A stop pulse is a mark (1) and is a minimum of 1.5 bits in length.

3.2.2. Code Requirements. The code to be transmitted will meet the following requirements.

3.2.2.1. Code to be used will be a Field Data Code, consisting of a 6-bit character, plus one odd parity bit.

3.2.2.2. The 2^0 power, or least significant information bit, is the first bit to be transmitted from each character.

3.2.2.3. Parity is to be the 2^6 power bit and is the last information bit of each character to be transmitted.

3.2.3. Message. The message to be generated by the measuring equipment system shall consist of the following:

3.2.3.1. Digital coordinate values in microns for each axis of the system shall normally consist of six decades (plus sign) per axis.

3.2.3.2. A start of message character (SOM).

3.2.3.3. An end of transmission character (EOT). (This bit configuration would normally be a parity error).

3.2.3.4. A message parity count (MPC). This is the sum of bits of all characters transmitted (including SOM and EOT), and is a non-carry add. Lateral parity is odd. Longitudinal parity is even. The parity bit is to be the sum of the longitudinal parity bits.

3.2.3.5. Four special instruction characters, each generated by four operator-controlled push on, push off back-lighted switches, two dummy bits (mark or 1), and a parity bit generated by the equipment based upon the condition of the four switches. The fixed dummy bits will occupy the 2^4 and 2^5 bit positions.

3.2.3.6. A special readout character generated by five momentary-contact push button switches and two fixed dummy bits occupying the 2^5 and 2^6 bit positions. The dummy bits are to be spaces or 0's. It is understood that the parity (2^6) is to be fixed at 0 so that if two of the five switches are pressed at the same time, a parity error will be detected. The five switches are to be understood as readout switches and will also control the request to send, SOM and text as later described.

3.2.3.7. Three rotary switches are to be provided for machine identification purposes. These switches are to have the capability to create 0 to 9 and are to be placed in the equipment so that only the maintenance engineers will have the capability to change them.

3.2.3.8. A minimum of 10 twelve-position rotary switches. These switches are to have the capability of producing 0 to 9, minus (-), and space.

3.2.3.9. The output sequence shall be as described in Appendix A.

3.2.4. Special Circuits. There is to be no character-by-character acknowledge signal received by the digitizer output circuit. However, there is to be a message acknowledge or error received on the basis of the total message transmitted. The reply will consist of SOM, A or E, EOT, and MPC. In addition, a timer is to be incorporated in the equipment to trigger an alarm if the reply is not received within 3 seconds. The output is to be held in the digitizer buffer until an acknowledge is received or the timer alarm is triggered. If an error signal is received due to a bad transmission, the timer is to be reset and another attempt at transmission is to be made. After a set number of attempts at retransmission (under computer control), an acknowledge or error signal will not be returned and the timer will cycle out. If a readout is initiated but never reaches the computer, the timer will also cycle out, warning the operator that the transmission has not taken place. The return acknowledge or error will not be transmitted until the digitizer transmission is completed.

In addition, an indicator light is to be placed on the control panel in close proximity to the readout switches. On depressing any one of the five readout switches the light is to turn on and remain on for approximately one second or until an acknowledge signal is received, whichever is longer. This will indicate to the operator that a readout has been initiated within the digitizer.

A numerical display of the coordinate system should be placed on the control panel within the operator's field of view. A reset button for each axis shall be placed on the control panel. It is also mandatory that a master reset button be provided, along with a manual set feature for each decade of the counter, to give the operator the ability to set the counter value to a pre-determined value other than zero. A set of two 2-position direction of count switches shall also be included on the control panel.

3.2.5. Sequence of Operations. Having properly set up the measuring equipment as instructed, the operator will procede to take measurements and thus transmit data. Prior to actuating the readout mechanism, he will set up the necessary computation instructions on the 16 push on, push off switches comprising the four instruction characters. Then, upon aligning the reference mark with the image, he will depress one of the five readout switches comprising the readout character.

Upon actuating one of the five readout switches, the digitizing system will set the timer, energize the readout indicator light, lock the count in the buffer and visual displays, and send the bit message to the computer. If the computer receives the message and there is no error in it, the computer will send back an acknowledge signal. When the digitizing system receives an acknowledge message, the buffer storage and visual display will be unlocked and the timer will be stopped. If the computer receives an erroneous message, the computer will return an error message to the digitizing system. When the digitizing system receives an error message, it will re-start the timer, energize the readout light, and retransmit the data. The computer has been programmed to repeat the error signal cycle only a set number of times. If after a set number of tries, the computer cannot accept a message, it will not reply to the digitizing system. When the digitizing system receives no reply, the timer completes its cycle, sets off an audible alarm, and releases the buffer storage and visual displays. When an alarm occurs, the operator is to reset the alarm circuits by a push button on the control panel and attempt inputting the message again. If this fails, he is under instructions to call Maintenance.

3.3. General Physical Requirements.

3.3.1. Circuit Design. Required performance and critical output timing demand maximum reliability and rapid maintenance. The circuitry must be solid state. Where possible, all circuitry should be on plug-in, printed-circuit cards, with a minimum number of different types used. The design should be to the highest possible commercial standards to insure maximum performance.

3.3.2. Console Design. The circuitry should all be mounted on standard racks which in turn should be mounted in a single console. The console should be on locking casters and should be of rigid enough construction to withstand constant (at least three or four times daily) moving about within an area. The control panel should be mounted on the console in such a manner that it could be easily viewed and reached by a seated operator. Space should be provided on or in the console for storing the "DIG" reading heads when they are not in use (the specifications for this mount cannot be determined until later).

3.4. Other Specifications.

3.4.1. Maximum storage shall be ±999999 for each axis.

3.4.2. The numerical display shall be an in-line Nixie tube or a 1" projection-type display. Negative numbers are to be displayed as true numbers with a sign (not 9's complement).

3.4.3. The power requirement for the device shall be 100 - 125 volts, maximum 15 amps, 60 cycle AC.

Attachment: Appendix A & B

APPENDIX A

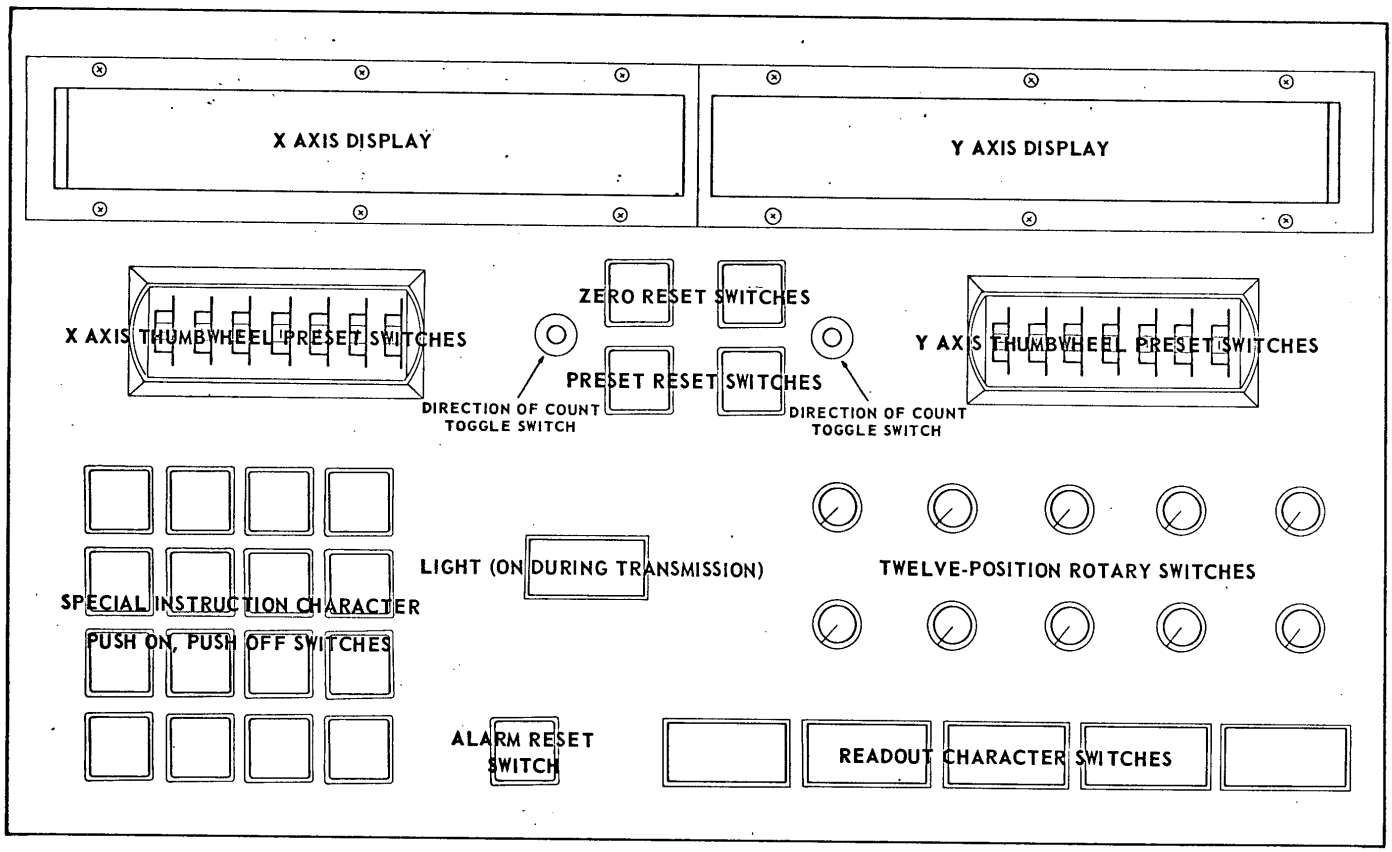
Typical Readout Sequence

Output Sequence		2^6	2^5	2^4	2^3	2^2	2^1	2^0
1.	SOM	1	0	1	1	0	1	1
2.	Readout Character	0	0	X	X	X	X	X
3.	Instruction Character	P	1	1	X	X	X	X
4.	Instruction Character	P	1	1	X	X	X	X
5.	Instruction Character	P	1	1	X	X	X	X
6.	Instruction Character	P	1	1	X	X	X	X
[illegible]	Sign plus	1	0	0	0	1	0	1
	minus	1	1	0	0	0	0	1
[illegible]	X value 10^5							
[illegible]	X value 10^4							
10.	X value 10^3							
11.	X value 10^2				0 to 9			
12.	X value 10^1							
13.	X value 10^0							
14.	Sign plus	1	0	0	0	1	0	1
	minus	1	1	0	0	0	0	1
15.	Y values 10^5							
16.	Y values 10^4							
17.	Y values 10^3							
18.	Y values 10^2				0 to 9			
[illegible]	Y values 10^1							
20.	Y values 10^0							
21.	(Machine identifiers)							
22.	(Machine identifiers)				0 to 9			
23.	(Machine identifiers)							
[illegible]	12 Position Rotaries							
25.	12 Position Rotaries							
26.	12 Position Rotaries							
27.	12 Position Rotaries							
28.	12 Position Rotaries							
29.	12 Position Rotaries							
30.	12 Position Rotaries				0 to 9			
31.	12 Position Rotaries	NOTE: The switches are prevented from turning to the twelfth position by mechanical stops.						
32.	12 Position Rotaries							
33.	12 Position Rotaries							
34.	EOT	1	0	1	0	1	0	1
35.	MPC	See text						

X = bits controlled by operator switches

P = Parity bit generated by equipment as required on the basis of the condition of the X positions.

	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0 =	1	1	1	0	0	0	0
1 =	0	1	1	0	0	0	1
2 =	0	1	1	0	0	1	0
3 =	1	1	1	0	0	1	1
4 =	0	1	1	0	1	0	0
5 =	1	1	1	0	1	0	1
6 =	1	1	1	0	1	1	0
7 =	0	1	1	0	1	1	1
8 =	0	1	1	1	0	0	0
9 =	1	1	1	1	0	0	1
- =	1	1	0	0	0	0	1
EOT =	1	0	1	0	1	0	1
Error =	1	0	0	1	0	1	0
Acknowledge =	1	0	0	0	1	1	0



CONTROL PANEL
MODEL 2825A

1 INCH = 2 INCHES

TAT